VOLUME 77 SEPARATE No. 71

Rochester Public Library
115 South Avenue

PROCEEDINGS

AMERICAN SOCIETY OF CIVIL ENGINEERS

MAY, 1951

RECTIFICATION OF THE PAPALOAPAN RIVER IN MEXICO

By Reynaldo Schega

WATERWAYS DIVISION

Copyright 1951 by the AMERICAN SOCIETY OF CIVIL ENGINEERS
Printed in the United States of America

Headquarters of the Society
33 W. 39th St.
New York 18, N.Y.

r620.6

PRICE $0.50 PER COPY

The Society is not responsible for any statement made or opinion expressed in its publications

---

HINTS TO AUTHORS

Those who are planning papers for submission to PROCEEDINGS *will expedite Committee action measurably by first studying the standard instructions as to style, content, and format. For reprints, address the Manager, Technical Publications, 33 W. 39th St., New York 18, N. Y.*

Published at Prince and Lemon Streets, Lancaster, Pa., by the American Society of Civil Engineers. Editorial and General Offices at 33 West Thirty-ninth Street, New York 18, N. Y. Reprints from this publication may be made on condition that the full title of paper, name of author, page reference, and date of publication by the Society are given.

Proceedings—Vol. 77 May, 1951 Separate No. 71

AMERICAN SOCIETY OF CIVIL ENGINEERS

Founded November 5, 1852

PAPERS

RECTIFICATION OF THE PAPALOAPAN RIVER IN MEXICO

By Reynaldo Schega[1]

Synopsis

In order to curb the frequent inundations of the fertile valley lands along the Papaloapan River, State of Veracruz (Ver.), Mex., the Papaloapan River Commission has undertaken a project to effect a lowering of flood stages by cutting off the worst bends of this meandering river. This project is to be supplemented eventually with flood-water storage on the tributaries for the dual purpose of flood control and the generation of electric energy. The rectification program, as regards procedure, is similar to that adopted on the lower Mississippi River.[2] Only pilot cuts have been excavated, and the final enlargement of these cuts, together with the closure of the abandoned river channels, is left to the river to accomplish. Six cutoffs in the process of development will shorten the 120-mile stretch of river 34 miles. When fully developed, the lowering of flood stage is conservatively estimated to range from 1.5 ft at the head of the tidal reach, increasing upstreamward to a reduction of as much as 6 ft where the confluence of the Santo Domingo and Tonto Rivers forms the Papaloapan River. A stage lowering approximating this magnitude was actually accomplished in this locality at the crest of the great flood of October, 1950, although none of the cutoffs was as yet fully developed.

The Papaloapan River

General Features.—The Papaloapan is a navigable river which ranks among the largest five rivers of Mexico. It drains a 17,390 sq mile watershed (2.3% of the total area of Mexico), largely mountainous, with headwaters descending from altitudes higher than 9,000 ft. The river empties into the Gulf of Mexico near Alvarado, Ver. Precipitation on the watershed ranges from a minimum of

Note.—Written comments are invited for publication; the last discussion should be submitted by October, 1951.

[1] Chf. Executive Engr., Papaloapan Commission, Vera Cruz, Mex.

[2] "Mississippi River Cutoffs," by Gerard H. Matthes, *Transactions*, ASCE, Vol. 113, 1948, p. 1.

15 in. per year in the arid easterly portion to a maximum of 100 in. per year in the mountainous areas of the interior, the gross average being 60 in. annually. The main stem which is formed by the confluence of the Tonto and Santo Domingo Rivers takes a tortuous northeasterly course 120 miles in length through a wide alluvial valley discharging first into the Laguna de Alvarado and from the latter into the Gulf of Mexico. Complicating the flood problem, two important tributaries from the southeastern part of the watershed discharge into the Papaloapan River a short distance before it reaches the Laguna. These are the Rio Tesechoacan and the Rio San Juan, which drain 2,040 sq miles and 3,950 sq miles, respectively. From the west the Rio Blanco, with a drainage area of 1,060 sq miles, also empties into the lagoon.

The valley of the Papaloapan is noted for its fertile soil, important crops being sugar cane, pineapples, oranges, and bananas. Several sugar mills and refineries and several canning factories are located along the banks. The Papaloapan is navigable for light-draft river craft for 144 miles except during extreme low stages, when the crossing bars in the upper reaches afford less than 3-ft draft. Below Cosamaloapan, Ver. (mile 62) the river is deep, and towboats hauling strings of six to eight barges laden with sugar cane can navigate. Above Alvarado the channel is tidal for 44 miles to Amatlan, Ver., and tides continue to be felt as far upstream as Cosamaloapan. Beyond this point the channel becomes a succession of deep bends alternating with shallow crossing bars characteristic of meandering streams.

Low-water slopes increase progressively from 0.25 ft per mile in the tidal reach to 1.0 ft per mile at mile 115, where the river bed attains an elevation of 16.5 ft above mean sea level. The river bed at this point is composed of coarse gravel and cobblestones. The principal tributaries, the Tonto, Valle Nacional, and Santo Domingo Rivers, are typical mountain streams.

Discharge Records.—At the time the project was first conceived little was known concerning the river's discharge. A gaging station had been established in 1947 at Papaloapan, Ver. (mile 115), where the river is crossed by a steel railroad bridge. The first gagings were made in May, 1947, and a continuous accurate discharge record has been kept. In the absence of any river survey, an aerial photographic mosaic, prepared by the Compania Mexicana Aerofoto at a scale of 1:20,000, has proved of great assistance in planning the location of the cutoffs. High-water marks preserved at a number of points along the river were utilized in the preparation of flood profiles.

The hydrographs of the gaging station at Papaloapan show the runoff from the watershed to have two well-defined periods, one of moderate or low flow (which begins usually in October and ends about the middle of May), and a high-water season, which extends from the middle of May to the last of September and sometimes into October. During the calendar year 1947 the total volume passing the gaging station at Papaloapan amounted to 13,196,520 acre ft. If the runoff from the lower watershed is added, the total discharge at the river mouth for 1947 is estimated to be 24,300,000 acre ft or 1,380 acre ft per sq mile of drainage area. This is equivalent to an average depth of runoff of 26 in. The runoff for the years 1948 and 1949 was 13,263,000 acre ft and 9,177,000 acre ft, respectively, at the Papaloapan gaging station.

Importance of Floods

The discharge capacity of the river channel below the confluence of the Santo Domingo and Tonto Rivers is about 106,000 cu ft per sec. As flood peak discharges of 140,000 cu ft per sec and larger occur almost every year, overflow of marginal lands between the towns of Papaloapan and Amatlan is a common occurrence. Damage so caused is estimated at some 5 million pesos annually. Historic floods of catastrophic proportions have occurred in 1552, 1604, 1714, and 1888, causing widespread loss of life. Recent great floods of this type occurred in September, 1944, and October, 1950, and had maximum discharges exceeding 200,000 cu ft per sec or about 15 cu ft per sec per sq mile of drainage area. These caused great material damage with loss of life and created unsanitary conditions. Towns along the river were inundated, as were the vast agricultural lands extending along both sides of the river, thereby effecting complete loss of crops.

TABLE 1.—Papaloapan River Flood Levels in Feet

River mile[a]	Location	1944 Flood		Elevation of flood crest 1947	Elevation of flood crest 1950	Estimated reduction[b]
		Elevation of flood crest	Depth of water on river bank			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.0	Alvarado, Ver.....	5.2	2.5	1.4	1.4	....
18.5	Tlacotalpan, Ver.....	9.8	2.5	5.7	6.6	....
30.0	San Miguel, Ver.....	11.8	2.5	6.9	8.8	....
43.5	Amatlan, Ver.....	15.4	2.6	11.6	13.3	1.4
52.0	San Cristobal, Ver....	17.4	2.5	14.5	17.1	....
62.5	Cosamaloapan, Ver...	21.0	2.5	18.4	19.7	3.9
71.0	Chacaltianguis, Ver...	24.2	2.7	21.2	22.6	....
80.0	Tuxtilla, Ver.....	28.2	3.3[c]	23.6	25.6	....
83.0	Novillero, Ver.....	30.3	3.3[c]	25.9	26.7	3.3
86.5	Tlacojalpan, Ver.....	31.4	3.3[c]	27.1	29.6	3.0
106.0	Otatitlan, Ver.....	43.3	4.0[c]	37.6	36.6	4.6
115.0	Papaloapan, Ver.....	50.6	4.8	43.0	44.1	6.1
....	Tuxtepec,[d] Oaxaca....	73.4	7.8	57.7	....	8.2

[a] Zero point for river miles is at Port of Alvarado. [b] Reduction of 1947 flood level after 3 yr cutoff operation
[c] Depth of water in town averaged about 5 ft. [d] Tuxtepec is on the Santo Domingo River.

Table 1 shows the elevation above mean sea level of recent flood crests at the various towns. The average depth of water on the river banks is shown for the flood of 1944, in which the maximum discharge exceeded 200,000 cu ft per sec. Within the towns, which are built on ground that is somewhat lower than the tops of banks, the depth of flooding was a foot or more greater. The town of Cosamaloapan escaped inundation in 1950 owing to levee protection. In the last column of the table are shown the highest stages registered during the flood of October, 1950, when the maximum discharge, as measured at the Papaloapan gaging station, was 220,000 cu ft per sec. Each flood season produces, as a rule, a succession of sudden stage rises at intervals of ten to twenty days followed by equally rapid subsidences. These rises decline toward the end of the flood season but recur characteristically in a minor way during the low-water season.

The Papaloapan River Project

Organization.—The catastrophic flood of 1944 was of such magnitude that the President of the Republic, General Avila Camacho, after an inspection tour of the affected region, declared it essential to the public welfare that measures for flood protection be instituted. He placed the planning and execution of the necessary works in the hands of the National Irrigation Commission, which was equipped with an organization and technical staff capable of undertaking the work. General Camacho's successor in office, President Miguel Aleman, expanded this organization into the present Ministry of Hydraulic Resources (Secretaria de Recursos Hidraulicos) headed by Secretary Adolfo Orive Alba, M. ASCE, whom he also appointed president of the Commission of the Papaloapan, created by presidential decree in April, 1947. The writer was placed in executive charge of operations.

Fig. 1.—Otatitlan Cutoff, Looking West

The project as conceived, is comprehensive. It is aimed not only at flood control but also at the development of all the natural resources of the region, including public water supplies and sanitation, the generation and transmission of electric energy by means of hydroelectric plants at high dams on the tributaries, the building of highways and bridges, the improvement of agriculture, and the general betterment of the standard of living of the people within this region. The Papaloapan Commission operates under the general direction of the Ministry of Hydraulic Resources and has the administrative and technical direction of planning and construction of all works required for the integrated development of the watershed.

Construction of Levees.—Prior to 1950 a vast expanse of agricultural lowland has remained subject to inundation by floods, because of the total absence of levees. This has since been remedied in part by building an embankment for a main highway along the river. This embankment, although not of great height, has served as a levee protecting the best agricultural areas west of the river.

The road extends the full length of the valley, connecting the towns of Ciudad Aleman, Novillero, Cosamaloapan, San Cristobal, Amatlan, San Miguel, and Tlacotalpan. This road is visible in Fig. 1 on the far side of the river at Otatitlan Cutoff. Built on one side of the river only, the presence of this embankment did not increase flood heights to any marked extent during the great flood of October, 1950. It did, however, save the important town of Cosamaloapan from being flooded on that occasion. It is realized that a similar embankment on the east side of the river would, through confinement of flood flow, inevitably create increased flood stages, as is the case in the lower Mississippi River. Therefore, it is planned to defer further levee construction until after flood water storage on the upper tributaries has been completed in connection with hydroelectric development. A number of dam and reservoir sites have been investigated on all of the principal tributaries, including those tributaries emptying into the lower reaches of the main river, and construction is under way on a dam at Temazcal (Ver.) on the Rio Tonto. This stream was a principal contributor to the flood of October, 1950, with a discharge of 107,600 cu ft per sec. This project includes a hydroelectric development.

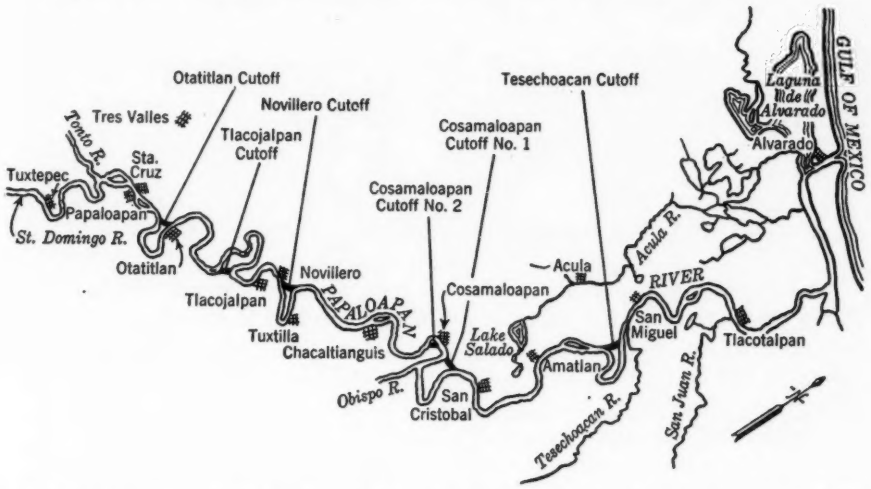

FIG. 2.—RECTIFICATION OF THE PAPALOAPAN RIVER, SCALE: 1 IN. EQUALS APPROXIMATELY 13 MILES

Planning the Cutoffs.—Inasmuch as dam building is time consuming, attention was given to river rectification and levee construction as early as possible as a means of bringing some measure of protection to the towns and agricultural interests of the valley. Rectification, in the case of the Mississippi River, had demonstrated the advantage to be achieved by use of the pilot-cut method, since an appreciable measure of flood-stage reduction could be realized long before the pilot cuts developed into full-sized river channels. Accordingly, on November 8, 1947, a plan for a rectification project was submitted to the Papaloapan River Commission. This plan contemplated a series of seven cutoffs spaced to eliminate excessive curvature yet without straightening the

river unduly. Gerard H. Matthes, Hon. M. ASCE (former head engineer of the Mississippi River Commission), after detailed inspection and study both in the field and at the office, approved the plan, indicating certain modifications intended to increase the stability of the future channel alinement as well as to promote proper automatic enlargement of the pilot cuts through the scouring action of floods.

Referring to the map, Fig. 2, the seven cutoffs were located and named as shown in Table 2. Except Tesechoacan, which was named for the tributary by that name, the cutoffs were named for the towns nearest to them.

A total length of 38.9 miles of river bends was thus to be eliminated, constituting a net shortening of 33.75 miles since the aggregate length of the cutoff channels is 5.15 miles.

TABLE 2.—PAPALOAPAN RIVER CUTOFFS

Name of cutoff	Location by River Miles		Length of river cutoff in miles	Length of pilot cut in miles
	From	To		
(1)	(2)	(3)	(4)	(5)
Tesechoacan	30.6	37.3	6.7	0.78
Cosamaloapan No. 1	51.6	59.6	8.0	0.72
Cosamaloapan No. 2	60.6	61.8	1.2	0.40
Novillero	75.3	80.7	5.4	0.58
Tlacojalpan	85.5	94.5	9.0	0.81
Otatitlan	102.3	108.5	6.2	0.66
Tuxtepec	114.6	117.0	2.4	1.20
Total length			38.9	5.15

As originally planned, the pilot cuts were to have bottom widths of 50 meters (164 ft) except the Tesechoacan Cutoff, located in the tidal section of the river that was to be made 100 meters (328 ft) wide. The widening of the pilot cuts and their eventual enlargement to the full width and depth of the stream were to be left to the natural forces of the river. The river's flow was expected to erode a total of 13,000,000 cu yd in the cutoff channels alone. This would be increased by 2,600,000 cu yd of spoil from excavation placed on the banks of the cuts, plus an amount of river-bed erosion estimated at 1,300,000 cu yd, making a total of about 17,000,000 cu yd to be moved by the river in the course of time. This time element could not be estimated since it was dependent not only on the magnitude and frequency of floods but also on the difference of time elements for individual cutoffs.

It was estimated that, after the first three years of operation of the pilot cuts, the height of a flood equal to that of 1947 would be lowered as indicated in Table 1.

Comparison of the flood crest elevations of 1950 with those of 1944 in Table 1 reveals a cumulative increase in flood-height reduction at the upper river stations due to the cutoffs. However, at points below Cosamaloapan no comparison is practicable because of tides and flood inflow from the lower tributaries.

Construction of Cutoffs

Bids for cutoff construction were invited in the late winter of 1947–48 during the low-water season. All bids presented had to be rejected, as none of the contractors was able to meet the time limit imposed by the beginning of high

Fig. 3.—Cosamaloapan Cutoffs, Looking West

water in the latter part of May. The specifications were strict in regard to the necessity of completing all excavation before the advent of the flood season because failure to do so meant the ruin by flood flow of any uncompleted pilot cuts with small prospect of repairing the damage except at considerable expense. Moreover, the difficulties involved in getting equipment to the sites of the work meant a serious loss of time. Owing to the urgency of getting the work started a contract was let to a company operating near the town of Cosamaloapan for the excavation of the pilot cut for Corte (Cutoff) Cosamaloapan No. 1 with reduced dimensions (Fig. 3). It was felt that this plan would be advantageous by affording an opportunity to observe the functioning of this pilot cut during the high-water season, thereby utilizing it as a guide for undertaking further pilot-cut excavations during the next low-water season. The contractor had at his disposition only two 2½-yd draglines, two bulldozers, and auxiliary equipment and could not attempt to excavate a channel larger than 20 meters (65.6 ft) bottom width, with side slopes of 1:1 and bottom elevation 6.56 ft below mean sea level, in the time remaining. Work was begun April 20, 1948, and completed May 27 of the same year. The excavation equaled 207,300 cu yd.

As the functioning of Cosamaloapan Cut No. 1 would set up strong currents along the left bank bordering the town of Cosamaloapan, where bank caving in previous years had destroyed several buildings, the need for excavating the pilot cut for Corte Cosamaloapan No. 2 was felt to be urgent. This was a short cutoff across a sharp point intended to relieve the high-water attack on the

TABLE 3.—PILOT CUT DATA—

Name of cutoff	Date commenced	Date finished	Length (feet)	Bottom width (feet)	Side slopes
(1)	(2)	(3)	(4)	(5)	(6)
Tesechoacan	February 15, 1949	June 5, 1949	4,048	165.0	1 on $\frac{1}{4}$
Cosamaloapan No. 1	April 20, 1948	May 27, 1948	3,677	65.6	1 on $\frac{1}{2}$
Cosamaloapan No. 2	May 14, 1948	June 17, 1948	2,066	65.6	1 on $\frac{1}{2}$
Cosamaloapan enlargement	May 20, 1949	July 22, 1949	2,066	42.6	1 on $\frac{1}{4}$
Novillero	April 28, 1949	June 21, 1949	3,198	98.4	1 on $\frac{1}{4}$
Tlacojalpan	February 27, 1949	June 14, 1949	4,986	82.0	1 on $\frac{1}{4}$
Otatitlan	June 10, 1949	July 18, 1949	3,608	82.0	1 on $\frac{1}{4}$

[a] Rate of exchange at the time contracts were

Cosamaloapan shore. A contractor offered to make a small pilot cut, using four tractors, four scrapers, and two bulldozers. His offer was accepted with a view of making enlargement with draglines at a later date. The total yardage of this excavation was 66,900 cu yd.

FIG. 4.—TLACOJALPAN CUTOFF WITH END PLUGS UNEXCAVATED

Soundings taken August 10, 1948, in the two Cosamaloapan pilot cuts revealed that the bottom of cutoff No. 1 had been eroded progressively in an

upstream direction commencing at the downstream end for a distance of 1,150 ft. This erosion equaled a depth of 10 ft bringing the bed elevation to 16.5 ft below mean sea level. Also, the cross section of the cutoff had been widened by 5 meters (16.4 ft) in a fairly uniform manner, thus preserving the gently curving alinement on which the pilot cut had been laid out. Pilot Cut No. 2 was found

PAPALOAPAN RIVER CUTOFFS

Entrance elevation (feet) (7)	Outlet elevation (feet) (8)	Maximum cut (feet) (9)	Minimum cut (feet) (10)	Excavation (cubic yards) (11)	Total cost (pesos)[a] (12)	Unit cost (pesos per cu yd) (13)
−14.8	−14.8	24	16.3	555,800	1,189,802.01	2.14
−6.6	−6.6	24	16.0	206,300	788,697.00	3.82
+1.6	+1.6	17	3.6	66,800	153,215.25	2.29
−6.6	−6.6	33	14.5	77,200	148,778.40	1.93
+1.3	−2.0	27	13.5	271,600	498,329.28	1.84
+3.3	0.0	30	3.3	449,000	820,860.10	1.83
10.5	+8.9	31	21.0	303,660	557,125.68	1.84

let was 8.65 pesos = 1 United States dollar.

FIG. 5.—TESECHOACAN CUTOFF

to have eroded its bed somewhat irregularly to a depth of about 1.5 ft, except at the two ends where bottom erosion had caused considerable deepening. Its cross section had gained in width about 15 ft.

Encouraged by the enlargement that had taken place in Pilot Cut No. 1 in three months' time, considering the fact that no floods of any magnitude had

occurred (the largest, on July 22, had a peak discharge of 76,800 cu ft per sec), it was decided to invite bids for the excavation of the remaining pilot cuts, except for Cutoff Tuxtepec, whose construction was to be held in abeyance pending formualtion of plans for a hydroelectric development in its neighborhood. On November 20, 1948, bids were advertised calling for excavation of the quantities shown in Table 3.

The bottom elevations in the pilot cuts were planned to afford sufficient depth for boats of 2-ft draft during the low-water season. In the Tesechoacan cut the depth of excavation was purposely increased because the river, being tidal and having a mild slope, could not be depended upon to effect much erosion except during major floods. Fig. 4 shows the Tlacojalpan Cutoff during construction, with the end plugs still unexcavated.

Sequence of Pilot-Cut Construction

In the execution of the project the procedure adhered to, as far as circumstances would permit, was to excavate the pilot cuts farthest downstream first and work progressively upstream. The principal advantage of this procedure was that any lowering of the river level affected by the opening of one pilot channel became at once transmitted with small loss to the site of the next pilot cut upstream. The enlargement of the upstream cut was thereby accelerated, due to steepening of the river and swifter currents. Stage lowerings, therefore, tended to be cumulative from pilot cut to pilot cut, diminished only by losses due to channel friction.

Materials eroded from individual pilot cuts often entered the abandoned channels of the cutoffs downstream and thus became permanently sidetracked and disposed of. The remainder found no lodgment in this manner but continued downstream, sometimes building bars in the river. Upon entering a pilot cut the eroded material was invariably carried through and passed on to the reaches below.

The outlined procedure represented in no sense a rigid schedule, nor did it limit the work of excavation to one pilot cut at a time. However, by having the work advance in an upstream direction, the benefits described proved material factors in accelerating pilot-cut development.

Construction Methods and Cost

Corte Tesechoacan.—Tesechoacan Cutoff (Fig. 5) was by far the largest pilot cut in terms of yardage of excavation, exceeding half a million cubic yards. As no hydraulic dredge could be procured, its width had been reduced to one half that originally planned. To handle this excavation with land machines, the contractor divided the job into two sections, separated by a 49-ft plug midway, in addition to the end plugs. Utilizing two 2½-yd, one 1½-yd, and one ½-yd draglines, assisted by four bulldozers, and four 13-yd trucks, the contractor started excavation simultaneously on both sections of the pilot cut, working in the dry until water level in the river was reached at El. 8.2 ft above mean sea level, a fairly high stage. He then concentrated all his equipment in the lower section and excavated it down to grade (El. − 14.8 ft mean sea level) keeping

down seepage water by pumping into the upper excavation with two 8-in. pumps. From this point pumps lifted the water into the river upstream. On completion of the lower section, the equipment was transferred to the upper

FIG. 6.—TESECHOACAN CUTOFF, LOOKING EAST

section, and after excavating this section, including the central plug, the two end plugs were removed. As may be noted from Table 3, the bottom elevation was given no slope, being uniformly at El. − 14.8 ft mean sea level. The river being tidal at this point, it was permitted to establish its own feeble gradient. Fig. 6 is an aerial view of the cutoff in operation during the 1950 high-water period. On the near side of the river can be seen the road embankment that acted as a levee to prevent flooding of adjacent lowland areas.

Other Cutoffs.—At the other cutoffs, the equipment and methods of procedure were, with some variation, essentially similar to those described for Cosamaloapan No. 1, except that in all cases final opening was effected by excavating the upsteram plug in its entirety. The dates of commencement and completion of excavation at each pilot cut, together with the cost, are listed in Table 3.

DEVELOPMENT OF THE PILOT CUTS

High river stages constitute the chief agency that effects the development of pilot cuts. Unfortunately, the high-water season of 1949 was lacking in high rates of runoff. Consequently, the development of the two Cosamaloapan pilot cuts (the only ones then built), although satisfactory, had been less than expected. This situation became reversed in 1950 when, a few months after

the completion of the remaining four pilot cuts, a flood of extraordinary proportions swept down the river. Its magnitude, coming during the early stages of these four pilot cuts, did not portend any good, and some damage was expected to result. On the whole, however, the results were better than expected. The only harmful effects were a few sand and gravel bars built up in the river channel at points between cutoffs. Formation of deposits of this kind had been expected. In anticipation the procurement of a light-draft cutterhead dredge for their removal had been urged.

The flood of October, 1950, effected considerable widening and also deepening of the pilot cuts. The pilot cut of Corte Otatitlan, which is located where the river's gradient is steepest, naturally suffered the greatest amount of erosion. In width it closely matches the width of the river. Its discharge capacity had increased to approximately 70% of that of the river. At ordinary and low stages the abandoned river bend appeared to be blocked with sediment deposits immediately below the head of the cutoff channel, and the cutoff carries the entire flow.

The pilot cut for Corte Tlacojalpan, next in order downstream, did not enlarge as much as at Otatitlan, owing to a tough, slow-to-erode, clay stratum at its mouth. The downstream portion of the cut passes through highly erodible sandy-silt soil and consequently has been heavily eroded. The width at this point approaches that of the river. The pilot cut for Corte Novillero (Fig. 7) has developed satisfactorily along its upper half; the lower half has widened

FIG. 7.—NOVILLERO CUTOFF

much less because of compacted silt deposits in a former oxbow lake that the cut must cross. Erosion there will necessarily be slow.

The two Cosamaloapan pilot cuts widened some 16 ft each. No. 1 showed this widening over two thirds of its lower length, while the small No. 2 pilot cut

eroded somewhat irregularly. The pilot cut for Corte Tesechoacan, which had been expected to enlarge very slowly owing to its location in the estuarial portion of the river, showed surprisingly good enlargement, gaining more than 40 ft in width.

Results

At the gaging station at Papaloapan the flood peak of October, 1950, registered 6.5 ft lower than the great flood of 1944. Since the maximum discharges of these two floods are believed to be fairly comparable, reduction in flood height of about 6 ft appears to have taken place in the reach of the river above Corte Otatitlan. This is in agreement with original estimates for three-year prospective results.

In general, the development of the cutoff project has been satisfactory as regards over-all aspects, more particularly in respect to flood-stage lowerings as described. Considering the short time that has elapsed since the pilot cuts were placed in operation, the project gives promise that it will justify its cost.

Acknowledgment

Successful completion of this project is the result of vigorous backing by President Miguel Aleman of Mexico. His foresighted policy established the comprehensiveness of the project. The aerial photography that was the basis for the actual construction was done by the Compania Mexicana Aerofoto. The photographs used in this paper were produced by that company. The original paper was written in Spanish and was translated into English by Frank C. Carey, M. ASCE. Subsequent revision and rearrangement was made by Mr. Matthes.

AMERICAN SOCIETY OF CIVIL ENGINEERS

OFFICERS FOR 1951

PRESIDENT

GAIL A. HATHAWAY

VICE-PRESIDENTS

Term expires January, 1952:

FRED C. SCOBEY
ALBERT HAERTLEIN

Term expires October, 1952:

WILLIAM R. GLIDDEN
DANIEL V. TERRELL

DIRECTORS

Term expires January, 1952:

WALDO G. BOWMAN
MORRIS GOODKIND
HAROLD L. BLAKESLEE
PAUL L. HOLLAND
EDMUND FRIEDMAN
S. T. HARDING

Term expires January, 1953:

OTTO HOLDEN
FRANK L. WEAVER
GORDON H. BUTLER
LOUIS R. HOWSON
G. BROOKS EARNEST
WALTER J. RYAN
GEORGE W. LAMB

Term expires October, 1952:

MILTON T. WILSON

Term expires October, 1953:

KIRBY SMITH
FRANCIS S. FRIEL
WALLACE L. CHADWICK
NORMAN R. MOORE
BURTON G. DWYRE

PAST-PRESIDENTS

Members of the Board

FRANKLIN THOMAS
ERNEST E. HOWARD

TREASURER

CHARLES E. TROUT

EXECUTIVE SECRETARY

WILLIAM N. CAREY

ASSISTANT TREASURER

GEORGE W. BURPEE

ASSISTANT SECRETARY

E. L. CHANDLER

PROCEEDINGS OF THE SOCIETY

SYDNEY WILMOT
Manager of Technical Publications

HAROLD T. LARSEN
Editor of Technical Publications

COMMITTEE ON PUBLICATIONS

WALDO G. BOWMAN

FRANCIS S. FRIEL
S. T. HARDING
OTTO HOLDEN
LOUIS R. HOWSON
NORMAN R. MOORE

N620